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MANPOWER, PERSONNEL, TRAINING AND SAFETY IN THE AIR FORCE WEAPON SYSTEMS ACQUISITION

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This report has been reviewed and is approved for publication.

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The U.S. Air Force is conducting a study to define a comprehensive and integrated Manpower, Personnel, Training and Safety (MPTS) System for use in the Weapon Systems Acquisition Process (WSAP). The study is identifying what MPTS decisions need to be made in the WSAP, when they need to be made, and how they need to be interrelated. Current capabilities are then being determined by analyzing the tools and data bases available to support each MPTS decision. The analysis will identify needed improvements to existing tools and data bases, and whether new ones need to be developed. This paper discusses the requirement for an improved MPTS system and then describes a variety of managerial and technical initiatives being undertaken to satisfy the requirement. The last section identifies the desired characteristics of an effective MPTS system.

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MANPOWER, PERSONNEL, TRAINING AND SAFETY IN AIR FORCE WEAPON SYSTEMS ACQUISITION

REQUIREMENT

Manpower, personnel and training (MPT) resources make up 40 percent of the total DOD budget. Consequently, reductions in the MPT support requirements of developing defense systems can significantly affect the structure of future DOD budgets. The uniformed services are also faced with manpower shortages resulting from a decline in the number of available recruits, while at the same time experiencing increasing demand for personnel to operate the many new defense systems in the inventory. This quandary dictates that more efficient use must be made of available manpower.

In addition to problems with cost and manpower availability, there is also concern over the increasing complexity of jobs. This concern is manifested in continuing increases in defense system complexity, threat and mission complexity, and operational requirements such as the need to improve survivability through dispersed basing. The narrow, highly specialized USAF career fields make it difficult to implement dispersed basing due to the increased specialization that would be required at each base. The USAF is investigating ways to broaden the scope of maintenance jobs, but historically, this approach has increased complexity by increasing knowledge and skill requirements.

The USAF needs the ability to perform trade-off studies on alternative weapon system designs and alternative MPT structures to develop the most cost-effective approach to accomplishing its mission. Akman Associates performed a study of the USAF MPT process in 1983 and concluded that: (a) MPT requirements were not being adequately identified during the early stages of the WSAP, nor were MPT considerations effectively included in early design trade-off decisions, or in the development of operational scenarios and maintenance concepts; (b) the USAF was unable to project the total MPT requirement in the future aggregated across all weapon systems or to project the impact on the total force structure of introducing new systems; (c) the USAF was very decentralized in managing MPT which made it difficult to integrate and monitor system related MPT requirements; (d) there were no formal requirements for timely reporting of system related MPT requirements; and (e) there were no effective incentives for either USAF or contractor personnel to constrain the MPT requirements of developing systems.

The USAF MPT process has not changed significantly since that time. While Akman Associates did not include safety in their analysis many of their conclusions apply to that area as well. The USAF safety program has been in existence for some time; safety personnel are matrixed to the program offices to identify safety problems and ensure safety warnings are posted. Because of its maturity and differing content, the system safety program has been dealt with as a separate program within the USAF. However, there are interfaces between safety and MPT. For example, safety hazards remaining in the system may increase training requirements or task performance times. Further, certain toxins or other hazards in the workplace could create new tasks, modify task procedures or necessitate protective work gear. Therefore, a comprehensive and integrated approach to the human sub-system must include all four elements of Manpower, Personnel, Training and Safety.

MANAGEMENT INITIATIVES

Congress has taken action to ensure they are informed of the total cost of a new defense system. They want to know the operations and support costs; not just the costs of building the system. The FY 87 DOD Authorization Act amended Title 10 of the U.S. Code and created Section 2434, entitled "Independent Cost Estimates: Operational Manpower Requirements." The law states, "The Secretary of Defense may not approve the full-scale engineering development or the production and deployment of a major defense acquisition program unless...the Secretary submits a manpower estimate of the program to the Committees on Armed Services of the Senate and the House of Representatives at least 90 days in advance of such approval." This manpower report covers the total number of people required to operate, maintain, and provide support to the system. It also includes the people required to train the above personnel and covers all military, civilian and contractor personnel involved in these activities.

In response to the law, the Assistant Secretary of Defense for Force Management and Personnel, ASD(FM&P), has drafted a DOD directive to formally integrate MPTS considerations into the acquisition process. However, each service will be able to establish their own service specific MPTS process within the DOD guidelines. Each service will be authorized to develop a process which is compatible with their unique missions, and which is consistent with the way they organize, train and deploy their people.

The USAF also has several initiatives underway to improve MPTS integration. The most significant of these has been the creation of the MPT Directorate within the Aeronautical Systems Division (ASD/ALH). This Directorate matrixes personnel into the various program offices to work MPT issues and help ensure the issues are addressed. ALH is also responsible for evaluating the effectiveness of current MPT techniques and management practices. Consequently, they play a major role in defining USAF research and development (R&D) requirements for MPT. Other initiatives include RIVET WORKFORCE and BLUE TWO. The RIVET WORKFORCE program is investigating the feasibility of broadening job structures to achieve a more efficient work force. BLUE TWO takes design engineers out into the field to learn how to operate and maintain equipment under field conditions; consequently, the design engineers become more sensitive to the user's needs.

TECHNICAL INITIATIVES

The USAF is conducting a study to define a comprehensive and integrated MPTS analytical system for use in the WSAP. The three phases of the study are described below.

Phase I. The first activity is the development of a descriptive model of the MPTS process in USAF acquisitions. A flow chart of the WSAP is developed at an appropriate level of detail to enable MPTS decisions to be linked to related WSAP activities. After the MPTS decisions have been defined, the analytical tools and data bases available to support these decisions will be identified. Current tools and data bases available from the Air Force, Army, Navy and private industry will be surveyed. Emerging technologies from DOD laboratories will also be evaluated. Criteria will then be developed for selecting the most relevant tools and data bases for in-depth analysis in Phase II.

The final activity of this phase is the identification of characteristics which will be used for the analysis of selected tools and data bases in Phase II. Data base characteristics include: (a) when it will be available in the WSAP; (b) what information it will contain and how the content will change as the acquisition process progresses; (c) how you will access and use it; and (d) what other data bases will it interface with. Analytic tool characteristics include: (a) what it does; (b) how it is used; (c) what data bases are needed to support it; (d) what are the interlinkages with other MPTS tools; (e) what is tool validity under specified conditions; and (f) how adequate is the tool (what are its strengths and weaknesses).

Phase II. During this phase the most promising tools and data bases identified in Phase I will be analyzed in detail. The information generated will be used to finalize the MPTS descriptive model. At the conclusion of this phase the model will consist of WSAP activities, related MPTS decisions and the analytical tools and data bases available to support those decisions. This information will be stored in an electronic data base (DBase 3+), which will operate on an IBM AT compatible personal computer (PC). This data base will be relational in nature. For example it will be able to: identify tools available to support a particular MPTS decision; identify data bases which can support a particular tool; and integrate this information across separate files to assist in analyzing the adequacy of current capabilities.

Phase III. The purpose of Phase III is to determine what additional R&D is required to achieve a comprehensive and integrated MPTS analytical system. The information collected in Phases I and II will be analyzed to determine: which MPTS decisions are unsupported or inadequately supported by current tools and data bases; what new tools and data bases are required; what improvements are needed to existing tools and data bases; and what interfaces need to be developed to provide an integrated system.

There are several promising technologies being developed by the U.S. Air Force Human Resources Laboratory (AFHRL) which could eventually be integrated into the MPTS system. Since the design engineer is the key to incorporating MPTS considerations into the design, one of the most promising areas is the integration of computer aided maintainability analysis with computer aided design (CAD). Computer programs are being developed which can analyze the supportability of a design while it is still being developed on a CAD system. One program uses an extensive anthropometric data base to determine a human's ability to perform required maintenance tasks. The program provides a pictorial representation of the human interacting with the equipment and takes into account not only physical dimensions but also characteristics such as strength. The program can also simulate the effect of wearing Arctic clothing or chemical defense gear.

However, the MPTS analytic capability must also be able to aggregate activity across tasks to predict operational unit level performance and evaluate alternative job structures. An AFHRL program entitled "Small Unit Maintenance Manpower Analysis (SUMMA)" is developing this capability (Wilson, Faucheux, Gray, & Wilson, 1987). SUMMA is a network of computer models and analytic techniques which will regroup tasks for maintenance personnel into new job structures to determine which ones are the most efficient in supporting the weapon system, given its design, development and support concepts. SUMMA also

provides suggested manning levels for the alternative job structures and predicts sortie generation rates. This analytical process thus provides the capability to evaluate alternative personnel structures in terms of their manning requirements and sortie generation potential. SUMMA also provides cost information on each job structure taking into account not only direct personnel costs but also support costs such as training.

The ability to assess unit level performance is not sufficient, however, to develop credible MPT constraints for the design of the weapon system. Credible MPT constraints cannot be placed on the contractor unless the USAF can predict its total MPT requirements in the future, and the impact on these requirements of introducing a new weapon system into the inventory. This process involves the ability to predict the level of additional MPT resources required to support the new system, or the need to retire other weapon systems if resource levels must remain constant. AFHRL is developing a total force impact model to provide the above capability, and also a transferability of skills model. The latter model provides an estimate of the time required to retrain individuals from one specialty to another, including a specification of the skills, knowledges and abilities that would have to be trained. The two models can be used together to help determine what would be required to restructure USAF personnel career fields to staff the new system.

The utility of these analytic tools is heavily dependent on extensive data bases which must be accurate and easily accessible. The anthropometric data bases must contain information on both physical dimensions and capabilities, must consider gender and race, and must be updated to reflect projected changes in the population. The data bases must also include information on performance under wartime conditions, and the effects of heat, cold and other stress factors on performance.

The ability of data bases to interface with one another is also important. There are numerous task level data bases generated which are incompatible. Some serve the personnel and training communities and have learning difficulty, aptitude, knowledge and skill requirements tied to tasks. Others serve the logistics community and provide task times to repair specific pieces of equipment. However, the definition of a task is significantly different between these data bases; in the past it has been impossible to cross reference between them. Techniques and software are being developed to make it possible to interface these data bases, so that when a task is identified on a new defense system, an estimate can be obtained from the personnel and training data bases on the aptitude, knowledge and skill requirements of that task.

DESIRED MPTS SYSTEM

An effective MPTS program begins during the preconceptual planning and mission analysis phase. The MPTS goals and constraints for the proposed system must be estimated so that controlling documents like the Statement of Operational Need (SON), System Operational Requirements Document (SORD), and Request for Proposal (RFP)/Statement of Work (SOW) will include the human-related constraints that the system must live within. To be credible, however, the constraints must be realistic. Realism requires the ability to predict the impact of introducing the new system into the inventory on total USAF MPT resource requirements. This concept involves the ability to predict the MPT requirements for the new weapon based on comparable systems in the inventory,

and estimating the total MPT resource requirements of all systems which will be in the inventory during the affected period. Easily accessible data bases must be provided to support these analyses, but when this capability is achieved decision makers will be aware of the MPT envelope within which the new system must be developed.

During the Concept Development Phase the major system and subsystem trade-off studies should consider MPTS issues. While only 3 percent of total program funding is spent by Milestone I (concept design) of the WSAP, approximately 70 percent of the MPTS costs are determined by that time. The priority of MPTS must be raised so that some of the early program funds can be devoted to MPTS analysis. Analytic tools must also be developed which can work with the less specific data available in pre-Milestone I.

MPTS considerations will not be seriously considered in the design of the weapon system until MPTS criteria are included in contract design specifications. The design engineer should be held accountable for MPTS criteria, just as he is for other design criteria. MPTS criteria must become a significant factor in proposal evaluation and source selection, design trade-off studies, and the system's test and evaluation program. To earn this level of credibility, the MPTS criteria must be sufficiently quantified to possess the same predictability as other factors considered in the design phase. Examples of measurable criteria include: crew size, turn around time, sortie generation rate, levels of maintenance, accessibility of frequently repaired items, mean time to repair, and mean maintenance hours per flying hour. These criteria must be closely tracked and evaluated in developmental and operational testing as documented in the Test and Evaluation Master Plan (TEMP). By placing MPTS testing requirements in the TEMP, the Government will be assured that the independent operational test and evaluation (OT&E) organization will test the human subsystem.

Another key to ensuring that MPTS criteria are being addressed is in the specification of contract data requirements. More than 300 Data Item Descriptions (DIDs) which refer to some aspect of MPTS are in use. Obviously the introduction of additional DIDs is not the answer. Currently, the DOD Human Factors Engineering Technical Advisory Group is conducting a 2-yr Engineering Practices Study to review and consolidate and reduce DIDs to fifty. The USAF is cooperating with the other services, NASA and industry in this effort. During this consolidating process the DIDs should, be modified to make them more compatible, and thus ease the integration process. At least one integration DID should also be developed to provide an overview, and highlight the interrelationship between the MPTS areas.

The final, and perhaps overriding, requirement is management commitment. The contractor will design to the MPTS constraints if they have the required analytic tools and data bases, and if the Government will pay for the extra design effort. Commitment will come from USAF program managers when their job performance is judged not just on performance, cost and schedule criteria, but also on operability and supportability. If the MPTS constraints are incorporated into the TEMP, they will be addressed at each major program review and evaluated during OT&E by the user and independent audit agencies. This is the program managers final report card; MPTS should be a part of it.

In summary, a major thrust to integrate MPTS considerations throughout the WSAP has begun within the USAF. Now, more than ever before, the advent of

computers and the interfacing of existing MPTS data bases will make it possible to consider people as a full sub-system, and influence design accordingly. It is essential that the MPTS data bases and analysis tools be integrated among themselves and with other weapon system data bases. In addition, commitment is needed, from senior management on down, to make the user, operator and maintainer, a central focus of weapon system design.

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